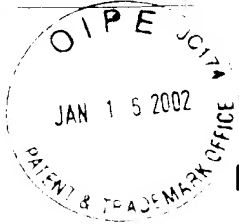




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Patentanmeldung Nr. Patent application No. Demande de brevet n°

00118670.9

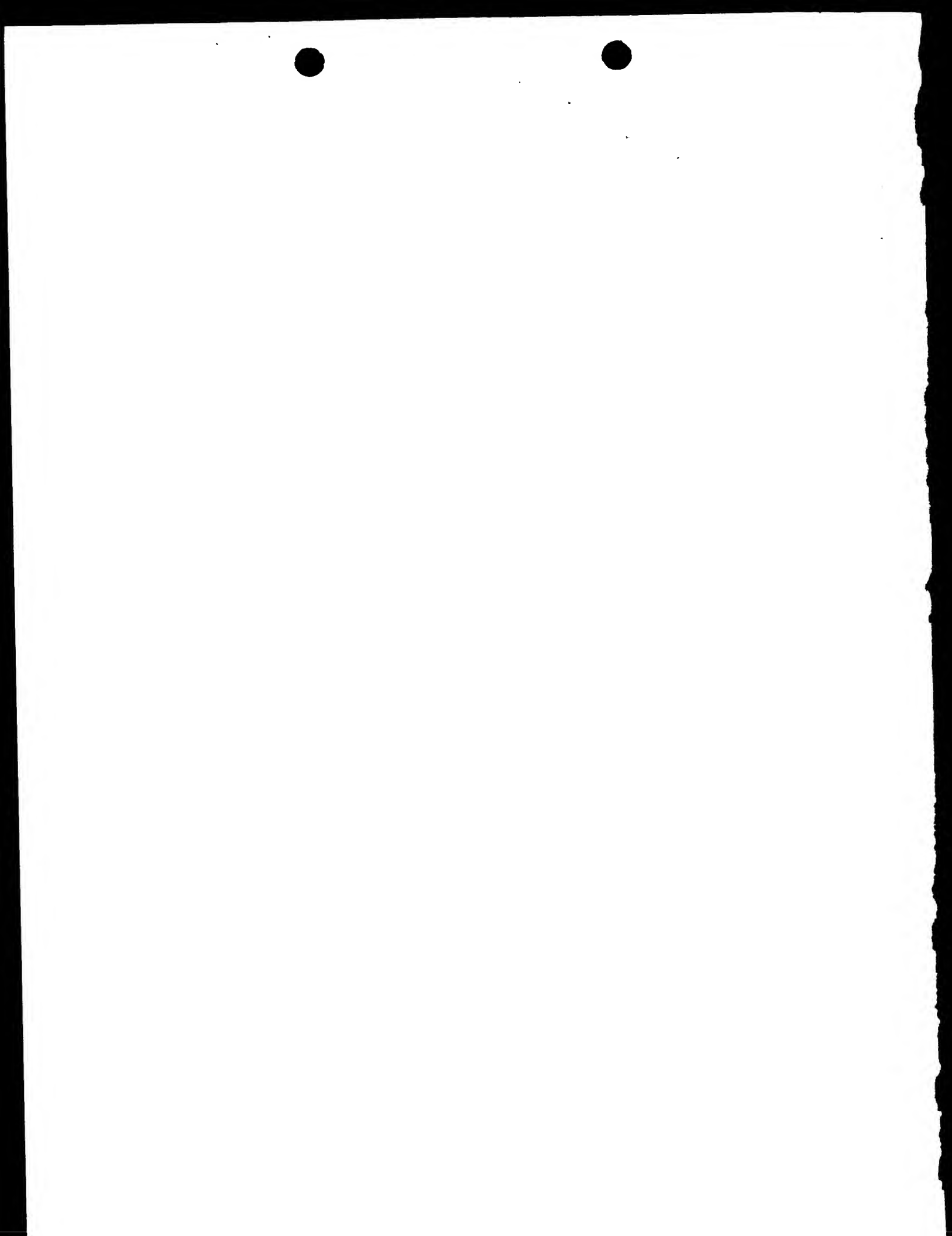
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Sheet 2 of the certificate
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Anmelder
Applicant(s)
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Semiconductor 300 GmbH & Co. KG
01099 Dresden
GERMANY

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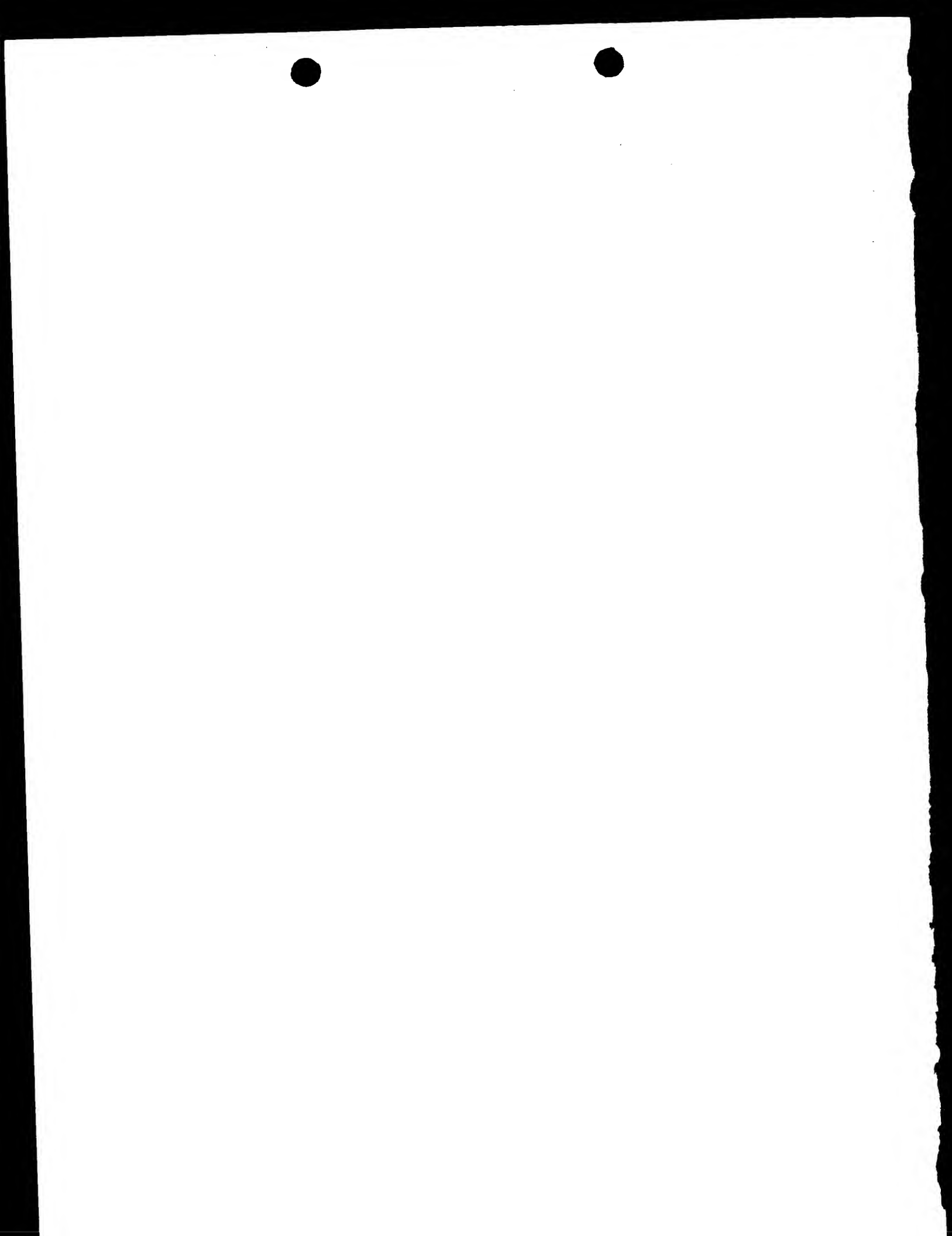
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Remarques



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SUSCEPTOR FOR SEMICONDUCTOR WAFERS

The invention refers to a susceptor for a semiconductor wafer.

5

In the field of semiconductor wafer manufacturing typical processing steps comprise CVD (Chemical Vapor Deposition), dry etching, sputtering, PVD (Physical Vapor Deposition), etc. In such processes the wafer located on a wafer susceptor, a so called wafer chuck. The wafer resides on the chuck with its back side, whereby the front side is subject to the application of reaction gases or physical/chemical treatment by the environment within the process chamber. In any of the above mentioned processes the wafer has to be heated through the chuck.

Semiconductor wafers are usually warped. The warpage is caused by one or multiple layers on the front side of the wafer which cause a tensile strength to the wafer. The wafer is warped either concavely or convexly when seen from its front side. Especially when the wafer is warped concavely, the warpage will be increased when the wafer is placed on a hot chuck in a process chamber. This is due to the fact that the center of the wafer is heated first thereby expanding the center portion of the semiconductor material so that the concave warpage is amplified. This often causes a moving or jumping of the wafer immediately after it is placed on the chuck. Wafer warpage is especially a problem with wafers having a diameter of more than 200 mm (10 inch) and especially with wafer diameters of 300 mm and more.

It is an objective of the invention to provide a susceptor for a semiconductor wafer which avoids a movement of the wafer when it is placed on the susceptor.

35

According to the invention this objective is solved by a susceptor for a semiconductor wafer, comprising: a surface, on

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which the wafer can be placed, whereby said surface has a concave shape, and a heating means thermally coupled to said surface for heating said surface.

- 5 The susceptor according to the invention has a surface for the accommodation of the semiconductor wafer, preferably a silicon wafer, which has a concave shape. With the concave shape of the susceptor surface any movement of the wafer is avoided, especially when the chuck is hot.

10 According to the concave shape of the surface a plane which is defined by an outer circle of the surface surrounding the center portion of that surface has a distance from the center of the surface. The distance between the circle with the
15 largest diameter and the center is characteristic for the concave shape of the chuck. The distance should be more than 200 μm . Preferably the distance is larger than 500 μm , especially when the chuck is designed for 300 mm wafers. For wafers with a diameter larger than 300 mm the distance can be
20 considerably larger than 500 μm . The characteristic distance between the plane which is defined by the largest circle of the chuck surface and the center of the surface should be such that a wafer having the largest possible warpage touches the surface of the chuck with its circumference. It is to be
25 avoided that the wafer has the first contact with the chuck through its center portion. When touching the hot surface of the chuck with its circumference, the outer portion of the wafer is heated first, so that it extends outwardly and thereby flattens the wafer. Thereby the chuck must be suffi-
30 ciently concave in form so that each wafer irrespective of its bowing or warpage always touches the chuck at its perimeter first. The above function both applies to wafers which are bowed concavely and wafers which are bowed convexly with respect to the wafer's front side.

35 For a hot chuck as for the application in process chambers for CVD, dry etch, sputter, and PVD the susceptor is made of

3

metal. Any type of metal suitable for such processes is acceptable. Preferred metals can be aluminum or titanium.

5 The chuck is coupled to a heating means which can heat the
chuck up to 400 °C. It is also conceivable that the chuck is
heated up to more than 400 °C. Any type of known heating
method can be applied, e.g. electrical heating or heating by
infrared lamps. Since the problem of wafer bowing becomes es-
pecially relevant in the semiconductor industry with 300 mm
10 silicon wafers, the invention is preferably applied to 300 mm
wafer production.

The surface of the chuck can be structured in any known way.
The surface may be smooth or may be provided with concentric,
15 projecting rings. The chuck can be provided with any other
type of structure. Also, any type of known means for holding
the wafer is acceptable, e.g. provisions for clamping the wa-
fer. Further, holes for the application of a vacuum within
the surface of the chuck can be provided at the chuck's sur-
20 face. When the chuck is structured it is to be noted that the
concave shape applies to the envelope curve of the surface.

The invention is now described with reference to the draw-
ings. In the drawings:

25 Figure 1 (a) and (b) show a chuck according to the invention
with a concave surface before a concave wafer is
placed onto the chuck (a) and after reaching ther-
mal equilibrium (b) and

30 Figure 2 (a) and (b) show the same chuck for the accomodation
of a convexly bowed wafer.

The chuck 1 in figure 1 (a) has an upper surface 10 which is
35 provided to receive a wafer 12. The bottom side 11 of the
chuck is shown as a plane surface for simplification pur-

4

poses. However, there are arbitrary shapes possible for the bottom side 11 of the chuck 1 which can comprise heating means or supporting means to fix the chuck within a process chamber.

5

The upper surface 10 of the chuck has a concave shape. This means that the outer portion 14 of the chuck is higher than the center portion 13. The chuck 1 has a circular shape. A circle on the surface 10 through the outer portion 14 defines a plane 15. The distance 16 between the plane 15 and the center 13 is characteristic for the concave shape of the surface 10 of the chuck. The wafer 12 to be placed onto the chuck has a diameter of 300 mm in the shown embodiment. The distance 16 for a 300 mm wafer is preferably 500 μ m or more. The distance 16 should be larger than the greatest possible bowing of the wafer 12.

As shown in figure 1 (b) the wafer 12 is flattened. This is due to the fact that the perimeter 17 of the wafer touches the surface 10 of the chuck first irrespective of the amount of bowing of the wafer. Since the chuck is heated to a temperature between 300 °C and 400 °C or more than 400 °C, the perimeter 17 of the wafer 12 is subjected to the heat first. As a result, the outer portion of the silicon material of the wafer 12 is heated first and expands and generates a force pulling outwardly within the silicon material. As a result the wafer 12 is flattened after an appropriate time period when placed onto the chuck. Thereby any jumping of the wafer, which may happen when a 300 mm wafer is placed on a hot chuck with a flat surface, is avoided. The flat state of the wafer is reached latest when thermal equilibrium is established.

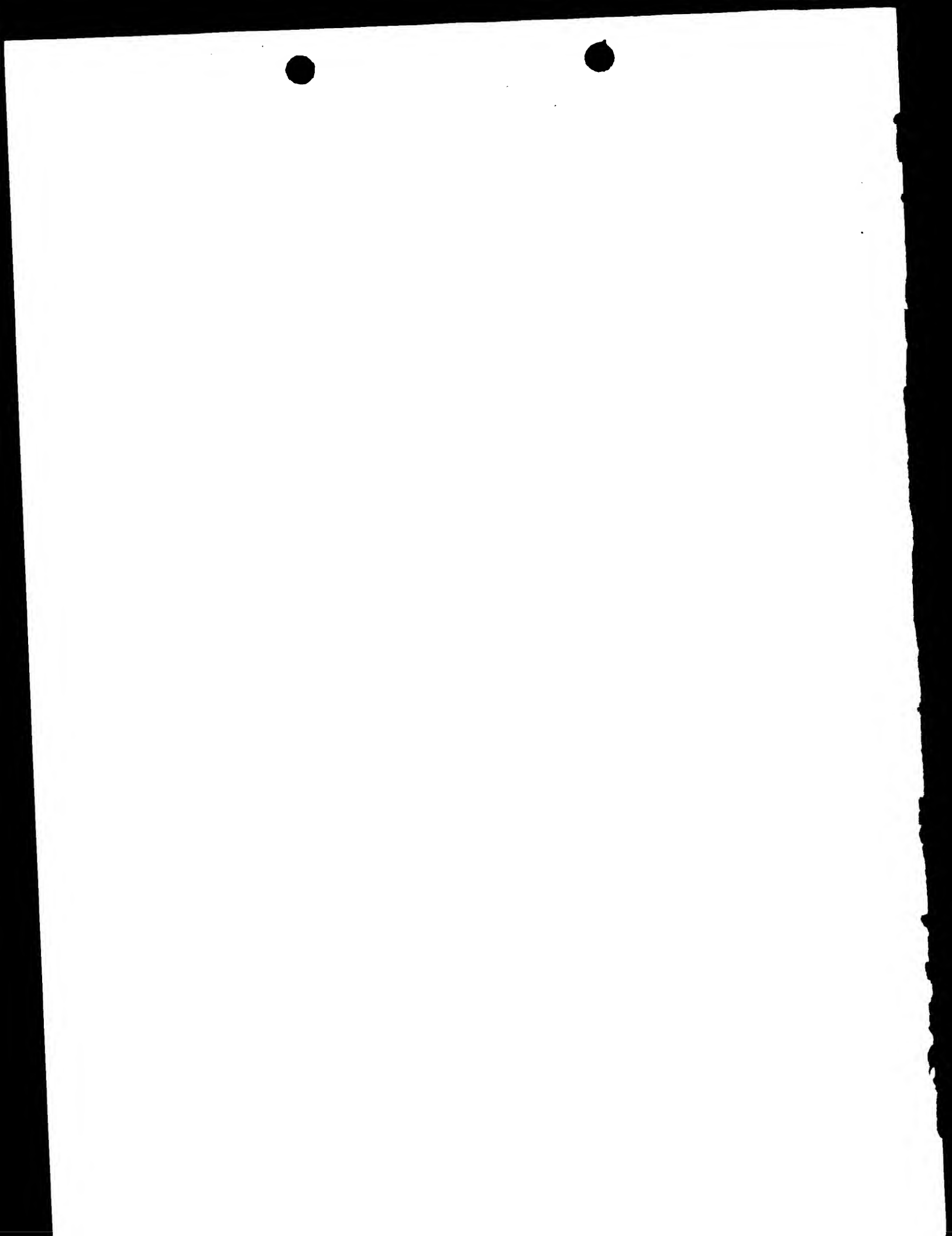
In figure 2 the chuck 1 is the same as in figure 1. The wafer 22 to be placed onto the chuck 1 has a convex bowing shape with respect to its front side. The back side of the wafer 22 is placed onto the concave formed surface 10 of the chuck 1. As with the concave shaped wafer 12 of figure 1, the convex

5

shaped wafer 22 of figure 2 also touches the surface 10 of the chuck 1 at its perimeter 27. The hot chuck 1 heats up the outer portion of the wafer 22 first so that an outwardly pulling force within the silicon material of the wafer 22 is generated which flattens the wafer until it is in the equilibrium state.

In any case, the chuck is designed so that the wafer 12, 22 establishes its thermal contact with the surface 10 of the chuck 1 at its perimeter edge. The difference 16 for the chuck 1 should preferably be in the range of 500 μm for silicon wafers having a diameter of 300 mm.

The chuck 1 has heating means attached to its bottom interface 11 which provide sufficient heat to the chuck. Preferably, the chuck surface 10 provides a heat of 400°C or slightly more to the wafer 12, 22. The surface 10 of the chuck 1 may have concentric circles which are projecting. Any other suitable microstructure of the surface 10 of the chuck is possible.



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Claims

1. Susceptor for a semiconductor wafer (12, 22), comprising:
 - a surface (10), on which the wafer (12, 22) can be placed,
 - 5 - whereby said surface (10) has a concave shape, and
 - a heating means thermally coupled to said surface for heating said surface.
2. Susceptor according to claim 1,
10 characterised in that
said surface (10) has a center portion (13) and an outer portion (14) surrounding said center portion (13), a distance (16) being formed between said center portion and a plane (15) defined by a circle (14) located on said outer portion
15 (14) of said surface (10), said distance being larger than 200 μm .
3. Susceptor according to claim 2,
characterised in that
20 said distance (16) is larger than 500 μm .
4. Surface according to claim 2 or 3,
characterised in that
said circle (14) has a diameter of 300 mm.
25
5. Susceptor according to any one of claims 1 to 4,
characterised in that
said susceptor is made of metal.
- 30 6. Susceptor according to claim 1,
characterised in that
said heating means is designed to heat said wafer (12, 22) to a temperature being at least 400 $^{\circ}\text{C}$.
- 35 7. Susceptor according to any one of claims 1 to 6,
characterised in that

7

the susceptor is designed to carry a silicon wafer of a diameter of at least 300 mm.

8. Susceptor according to any one of claims 1 to 7,
5 c h a r a c t e r i s e d i n t h a t
said surface (10) is provided with by concentric projecting
rings.

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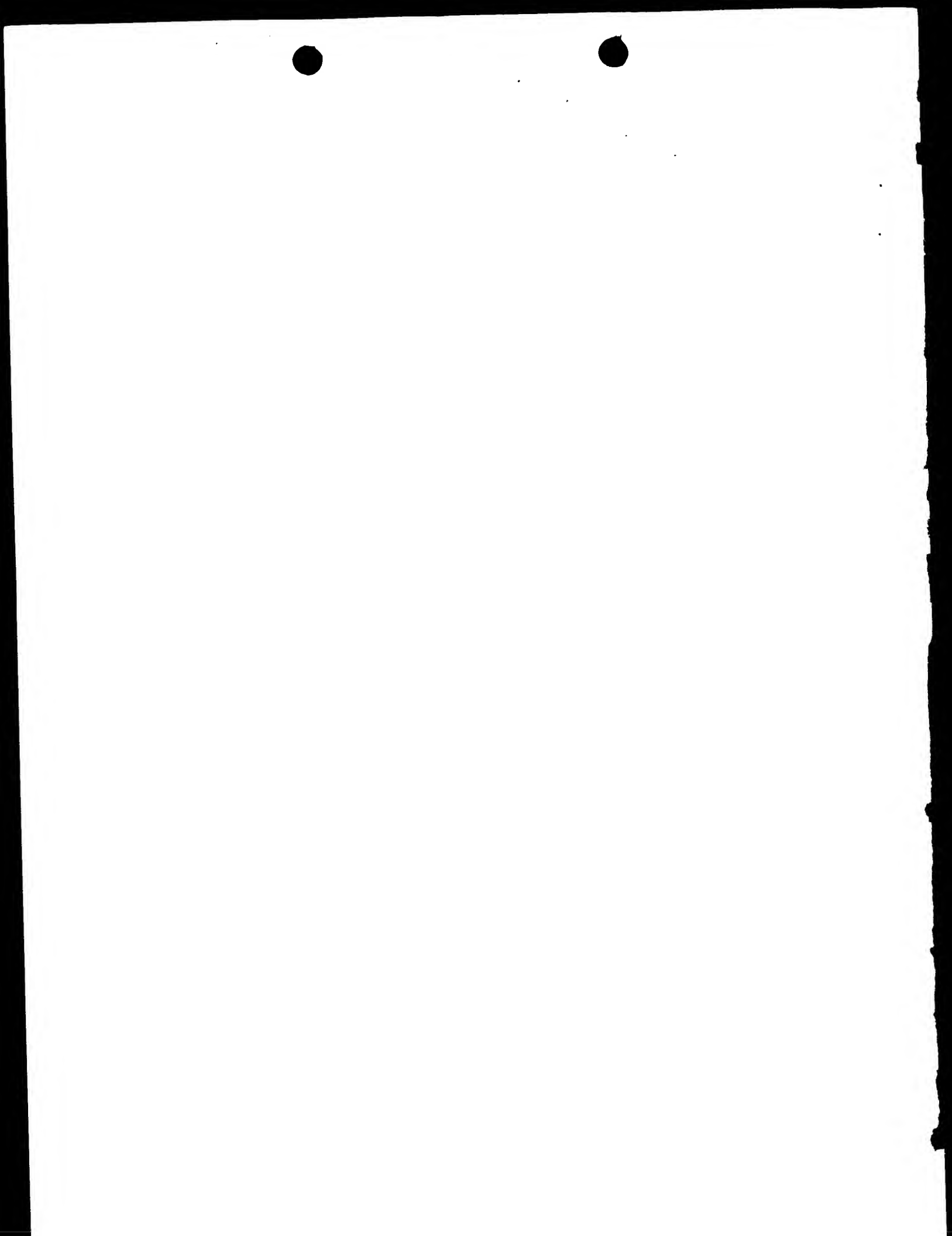
Abstract

SUSCEPTOR FOR SEMICONDUCTOR WAFERS

5 A wafer chuck (1) for semiconductor wafer manufacturing has a
surface (10) for the accommodation of a semiconductor wafer
(12). The surface has a concave shape. The wafer, especially
with a diameter of more than 300 mm, normally has a concave
or convex warpage according to tensile strength from depos-
10 ited layers. By appropriate size of the concaveness of the
chuck surface (10) the perimeter edge (17) of the wafer (12)
always touches the hot surface (10) of the chuck (1) first,
so that the wafer is flattened thereby avoiding a movement of
the wafer on the hot chuck surface (10).

15

Figure 1



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FIG. 1

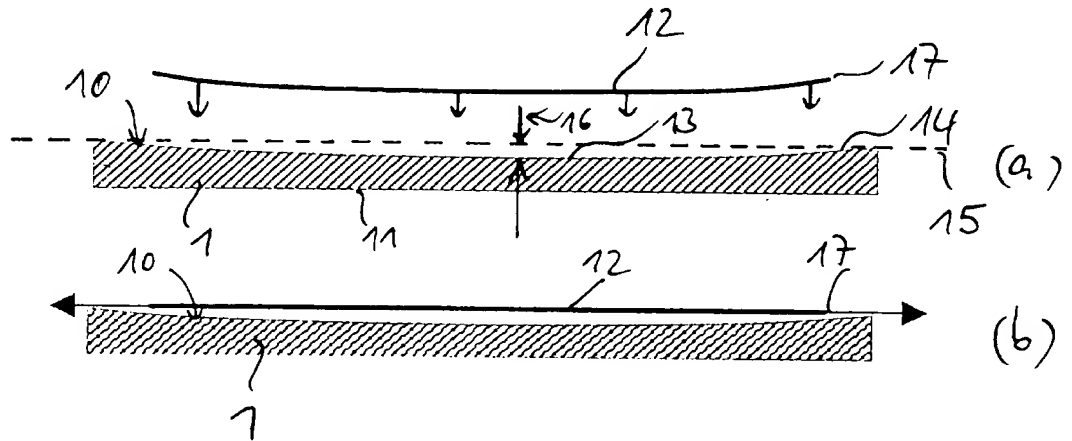


FIG. 2

